Transition Support of Meteorology and Oceanography (METOC) Technology to the Mission Support Center

John Joseph
Dept of Oceanography
Naval Postgraduate School
Monterey, CA 93943

Award Number: N0001406WR20139

LONG-TERM GOALS

The goals of this team effort are to develop, demonstrate and transition the probabilistic method for characterizing and quantifying environmental acoustic uncertainty to the fleet. Also, adaptive sampling strategies for the reduction of uncertainty in fleet ocean and acoustic models will be developed and advanced data assimilation methods will be applied.
The NPS portion of this effort is focused on development of algorithms, methodology, software and interfaces for the Naval Oceanographic Office to use adaptive sampling to improve predictions for anti-submarine warfare (ASW).

OBJECTIVES

The objectives of this research are to i) apply uncertainty analyses to APB (Advanced Processor Build) data sets with sonar operation detection calls; ii) work with CNMOC and NAVO to transition the algorithms, method and archive appropriate data sets into operational systems in order to reduce uncertainty in fleet ocean surveys, and iii) develop adaptive sampling tools and strategies based on data assimilation methods to reduce uncertainty in fleet ocean and acoustic models.

APPROACH

Our approach is based on a multi-disciplined effort using oceanographic expertise from the Woods Hole Oceanographic Institution (WHOI) and ocean acoustics expertise from the Naval Postgraduate School (NPS). This team was part of the ONR Capturing Uncertainty DRI, and the basic tools to apply to this program were developed under this program.

WORK COMPLETED

In 2006, NPS developed algorithms designed to generate 3D objective maps of ocean and acoustic parameters based on assimilation of near real-time physical oceanography data collected from a variety sensing platforms. The algorithms also generate uncertainty maps based on time and location of assimilated data. The objective map algorithms provide users flexibility in its application. The grid is easily relocated in geo-referenced coordinates. Orientation and resolution can be adjusted based on situational needs.

NPS also received a copy of the Navy Standard Parabolic Equation (NSPE) acoustic model package, requested through the METOC community's OAML Committee. NRL Stennis provided the latest

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **30 SEP 2006**	2. REPORT TYPE	3. DATES COVERED **00-00-2006 to 00-00-2006**

4. TITLE AND SUBTITLE **Transition Support of Meteorology and Oceanography (METOC) Technology to the Mission Support Center**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Postgraduate School,Department of Oceanography,Monterey,CA,93943**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR’S ACRONYM(S)
	11. SPONSOR/MONITOR’S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**3**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

available software package (NSPE ver 5.4) and associated documentation. NRL personnel also provided assistance in compiling the software to run in a Windows XP environment to be used in conjunction with output from the objective mapping algorithms, also run in a Windows XP environment.

Equipment was purchased for storage of large data sets to support analysis of exercise data.

RESULTS

The suite of algorithms used for objective mapping have been tested with real world data various ocean sensing platforms including REMUS vehicles, Scanfish tows, CTD casts, XBT casts and gliders. Data were made available by team members from various experiments throughout the year. In the AWACS portion of the Shallow Water 2006 experiment, data from Scanfish, multiple gliders and XBTs were successfully assimilated collectively on a 6-hourly update cycle to generate objective maps of the highly complex and dynamic shelf-break front off the coast of New Jersey. Uncertainty maps of the parameter of interest were also generated based on the distance from the measurement and time since the measurement was made. Correlation lengths and time were determined *a priori* based on statistical analysis of the region of interest.

Also during SW06, sound speed profiles generated as output from the objective map algorithms were used as input to the Range-dependent Acoustic Model (RAM) portion of NSPE to predict transmission loss (TL) along selected paths in acoustic experiments. As the experiment was recently completed in mid-September, comparison of predicted results to measured TL has just begun. Examples of typical output products are provided in figure 1.

IMPACT/APPLICATIONS
TRANSITIONS

Full analysis is still in progress, however a "quick look" at results from SW06 indicates this suite of objective mapping algoithms used with NSPE can quickly generate reliable range-dependent TL predictions based on data collected through various paltforms. Uncertainty maps based on spatial and temporal distribution of measurments offer the end user a level of confidence in the TL characterization of the region of interest and provide a basis to adapt the sampling scheme.

RELATED PROJECTS

The Capturing Uncertainty DRI has laid the foundation for this work helping to enhance understanding of uncertainty in the ocean environment and to characterize its impact on tactical system performance through data analysis, modeling and sensitivity studies. Similar applications are being developed in the Autonomous Wide Aperture Cluster for Surveillance (AWACS) project sponsored by Tom Curtin (ONR Code 32). Some of the data and processing algorithms are shared.

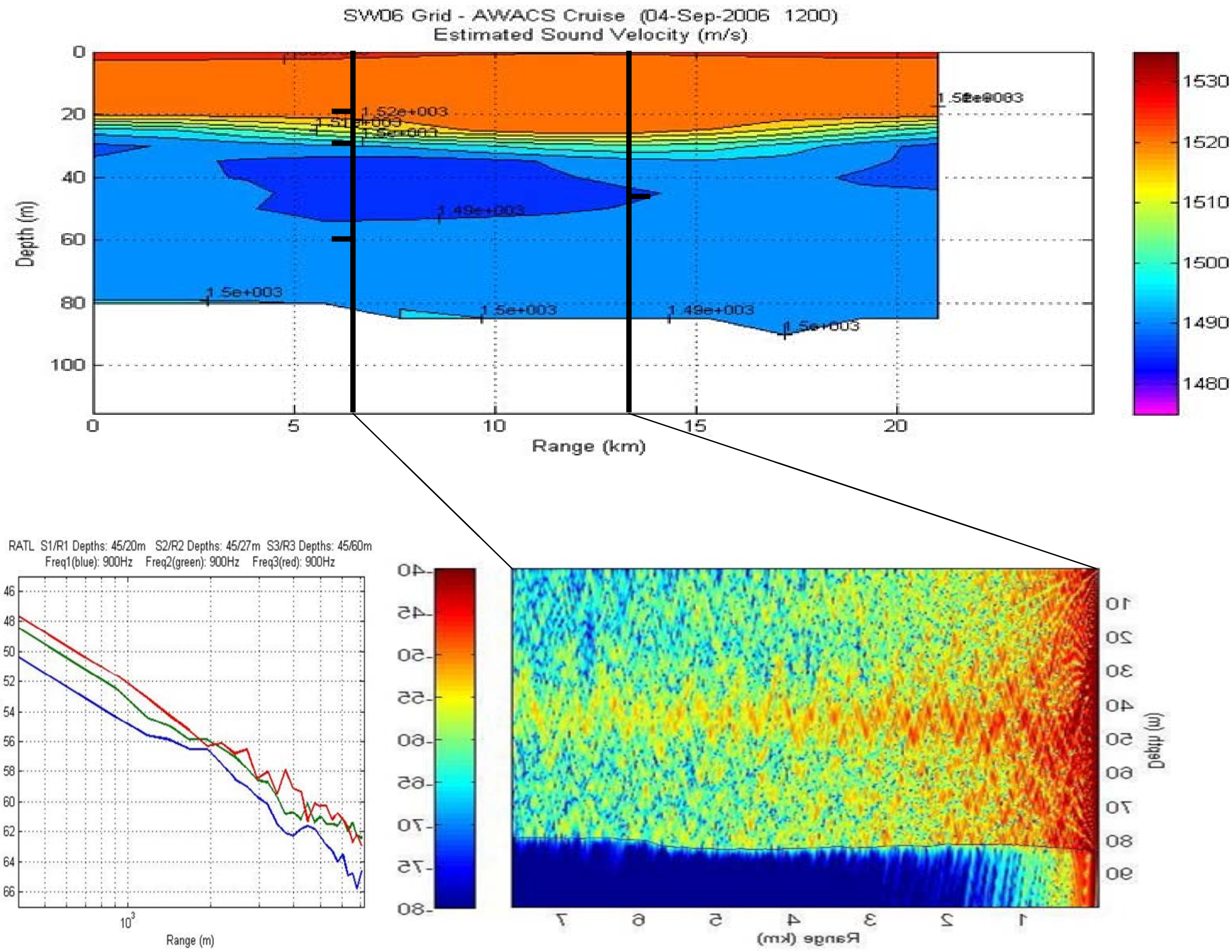

Figure 1. (Top) Example of vertical slice of sound speed extracted from objective map algorithms during SW06. Source depth at 45m shown near 13.5km range. Receivers at 20m, 27m and 60m shown near 6km range. (Bottom left) Range averaged transmission loss for each source-receiver pair for receivers at 20m (blue), 27m (green) and 60m (red). (Bottom right) Full field transmission loss for 900Hz signal predicted sound energy duct primarily focused between 27m and 60m receivers, providing only slightly stronger signal at these receivers compared to 20m receiver in surface layer. This image reversed to match propagation direction relative to sound speed map above above it.